

# **A Study of Leading Baryon and Antiproton Production in pA Collisions at the AGS**

An Tai (UCLA)  
for the E941 Collaboration

- Motivation of the experiment
- Measurements in E941
- Preliminary results
- Conclusion

**More details about the experiment, see posters given by B. Fadem and A. Rose**

# Motivation of the experiment

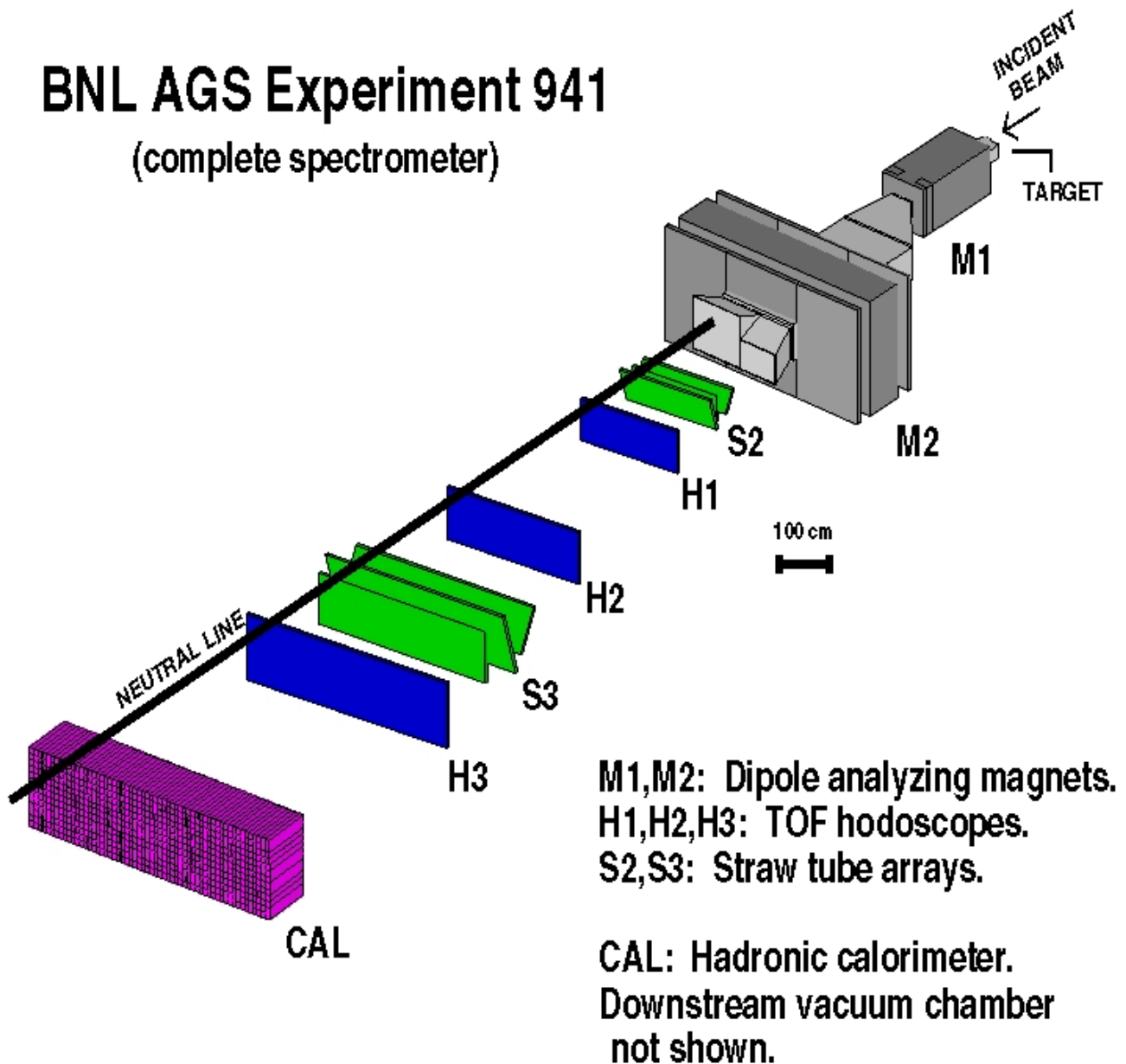
- Projectile fragmentation in pA  
resonance production ; diquark-  
quark; diquark break etc.  
help to understand baryon stopping  
in AA
- Study isospin exchange reaction  
a large cross section for the leading  
neutron production  
RQMD p+Au at 19 GeV/c, 25%  
neutron
- Antiproton production and  
absorption

## A unique experiment for studying leading baryon production in pA collisions at the AGS

- Measurement of both charged and neutral particles
- Large phase space coverage in the forward region and high data rate.
- E941: four targets (Be, Al, Cu, Pb) at 12 GeV/c and 19 GeV/c

# BNL AGS Experiment 941

(complete spectrometer)



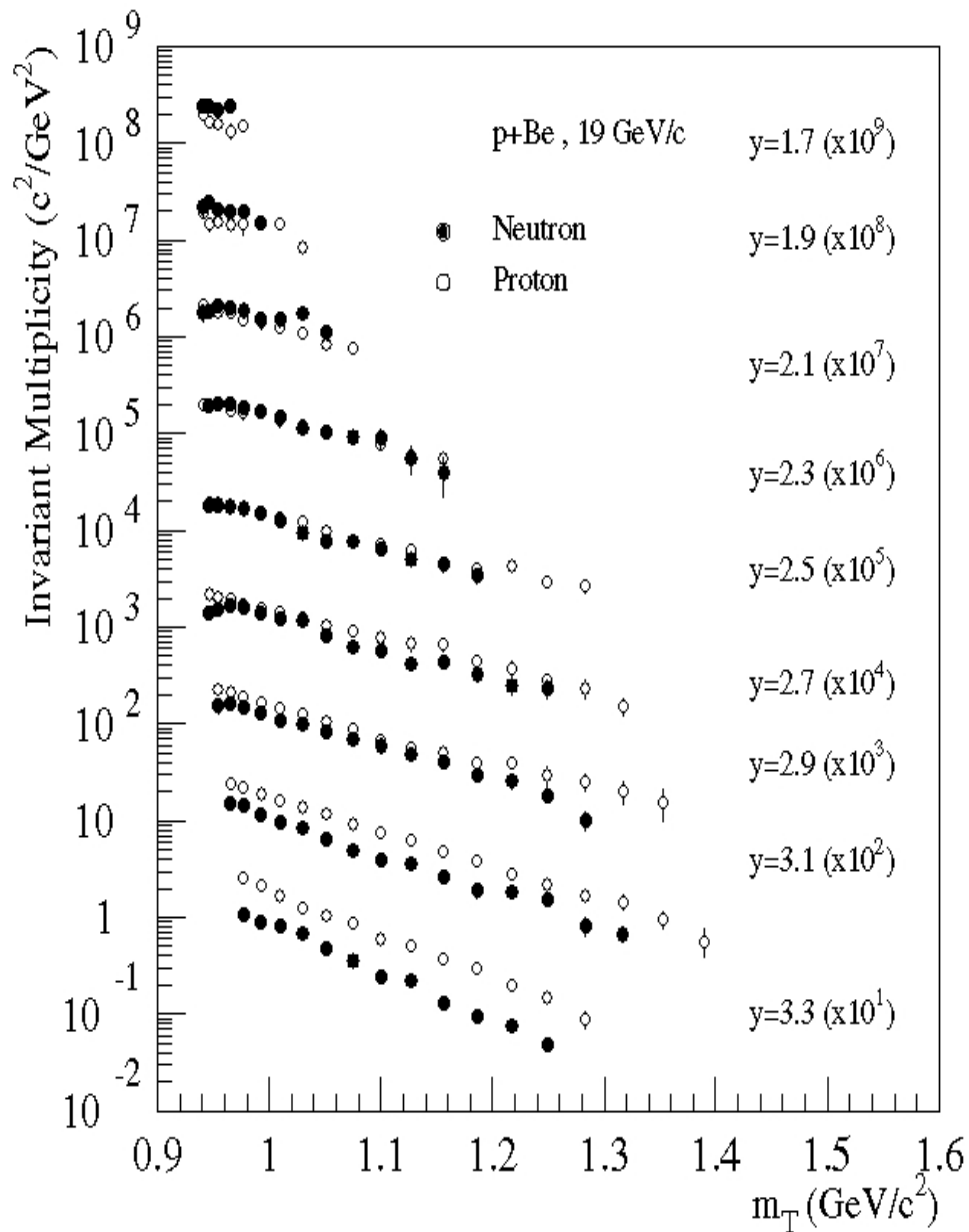
J.K.Pope October 1, 1996

E864/E941 spectrometer.

Jan. 14-21, 2001, Stony Brook

# Invariant Multiplicity Distribution

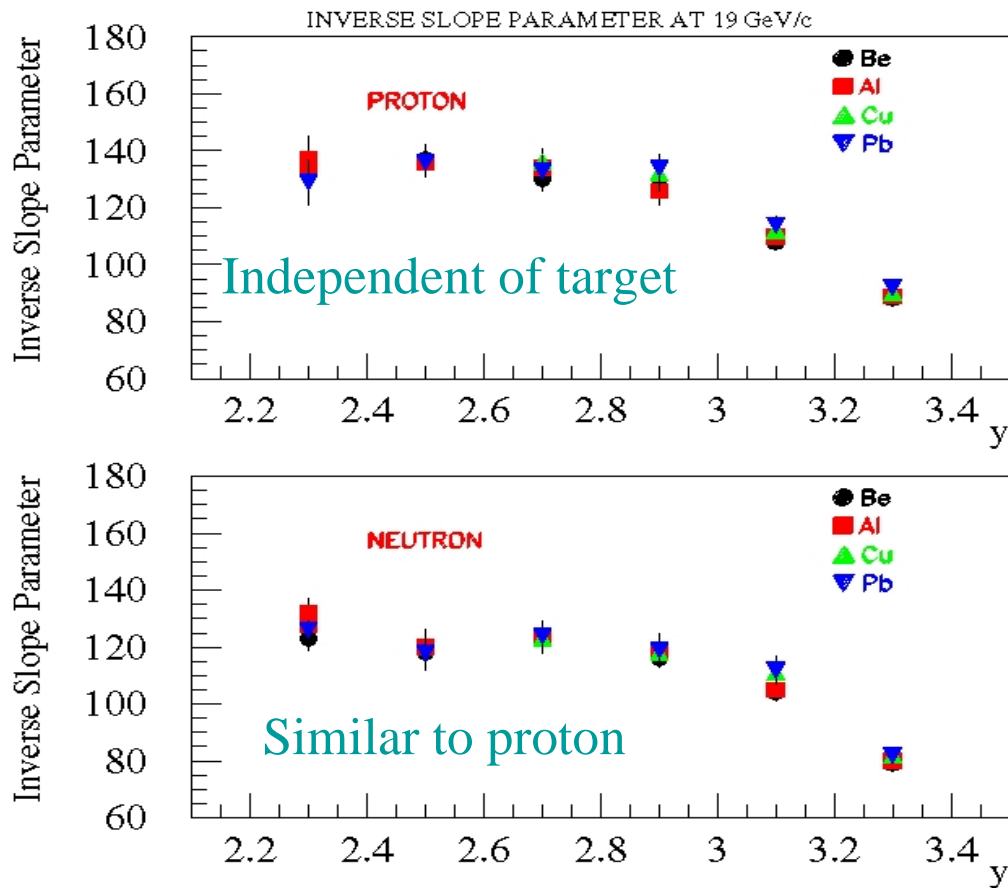
More protons are measured at large  $y$  than neutrons



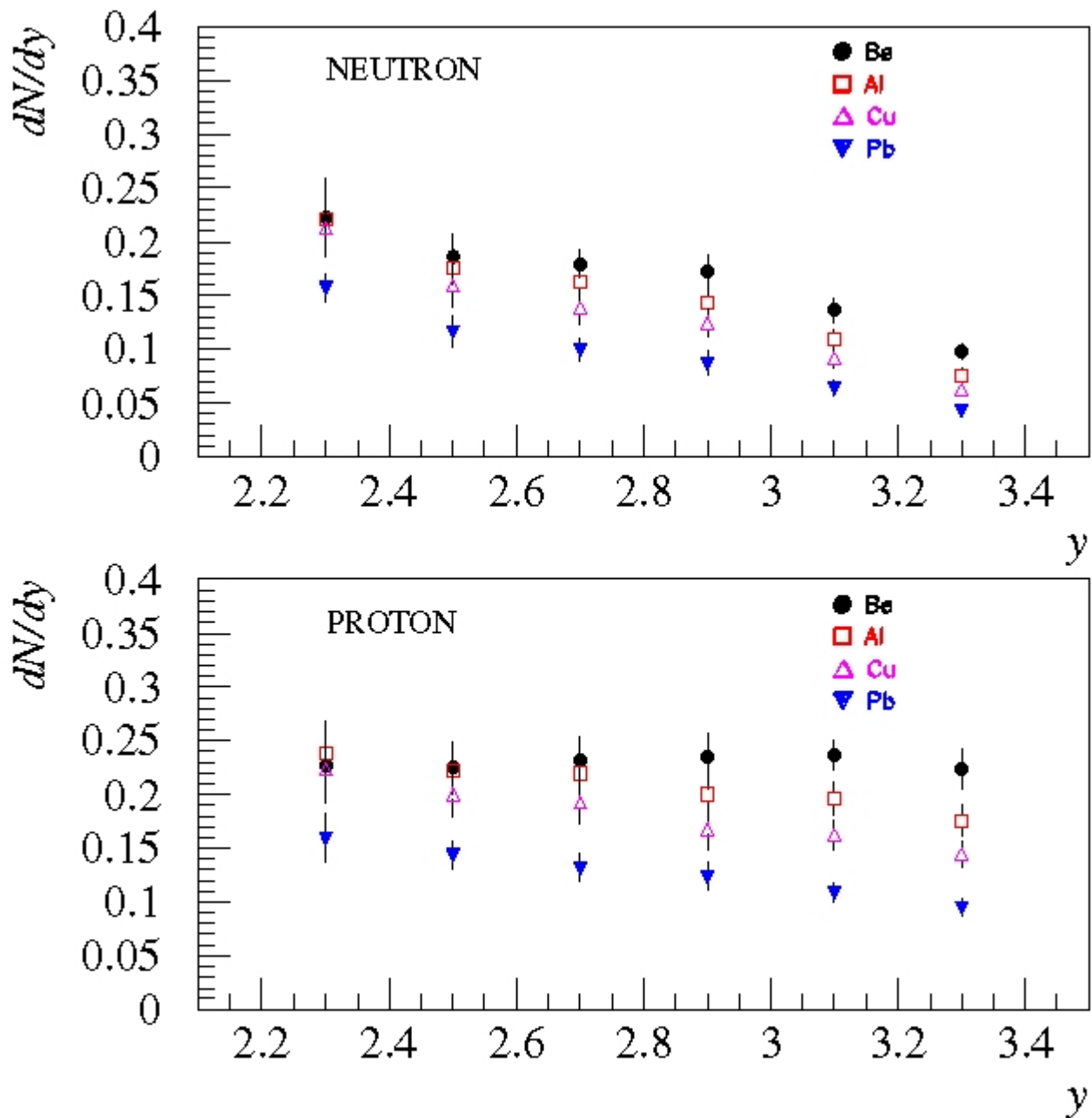
$E \frac{d^3N}{d^3p}$  of the leading baryon as a function of  $m_T$  for p+Be at 19 GeV/c.

# Inverse Slope parameters at 19 GeV/c

rapidity	2.3	2.5	2.7	2.9	3.1	3.3
Neutron Be	123 $\pm$ 4	118 $\pm$ 6	124 $\pm$ 4	116 $\pm$ 3	104 $\pm$ 3	79 $\pm$ 2
Proton Be	137 $\pm$ 8	137 $\pm$ 5	130 $\pm$ 4	127 $\pm$ 4	108 $\pm$ 1	88 $\pm$ 2
Neutron Al	128 $\pm$ 4	120 $\pm$ 4	123 $\pm$ 3	118 $\pm$ 3	105 $\pm$ 3	80 $\pm$ 2
Proton Al	135 $\pm$ 8	136 $\pm$ 5	134 $\pm$ 5	126 $\pm$ 5	110 $\pm$ 2	89 $\pm$ 2
Neutron Cu	132 $\pm$ 5	120 $\pm$ 6	123 $\pm$ 5	118 $\pm$ 5	111 $\pm$ 4	82 $\pm$ 2
Proton Cu	137 $\pm$ 8	136 $\pm$ 5	136 $\pm$ 5	132 $\pm$ 6	112 $\pm$ 3	90 $\pm$ 2
Neutron Pb	126 $\pm$ 3	118 $\pm$ 6	124 $\pm$ 5	119 $\pm$ 6	112 $\pm$ 5	82 $\pm$ 1
Proton Pb	129 $\pm$ 8	136 $\pm$ 4	133 $\pm$ 5	134 $\pm$ 5	114 $\pm$ 3	92 $\pm$ 2

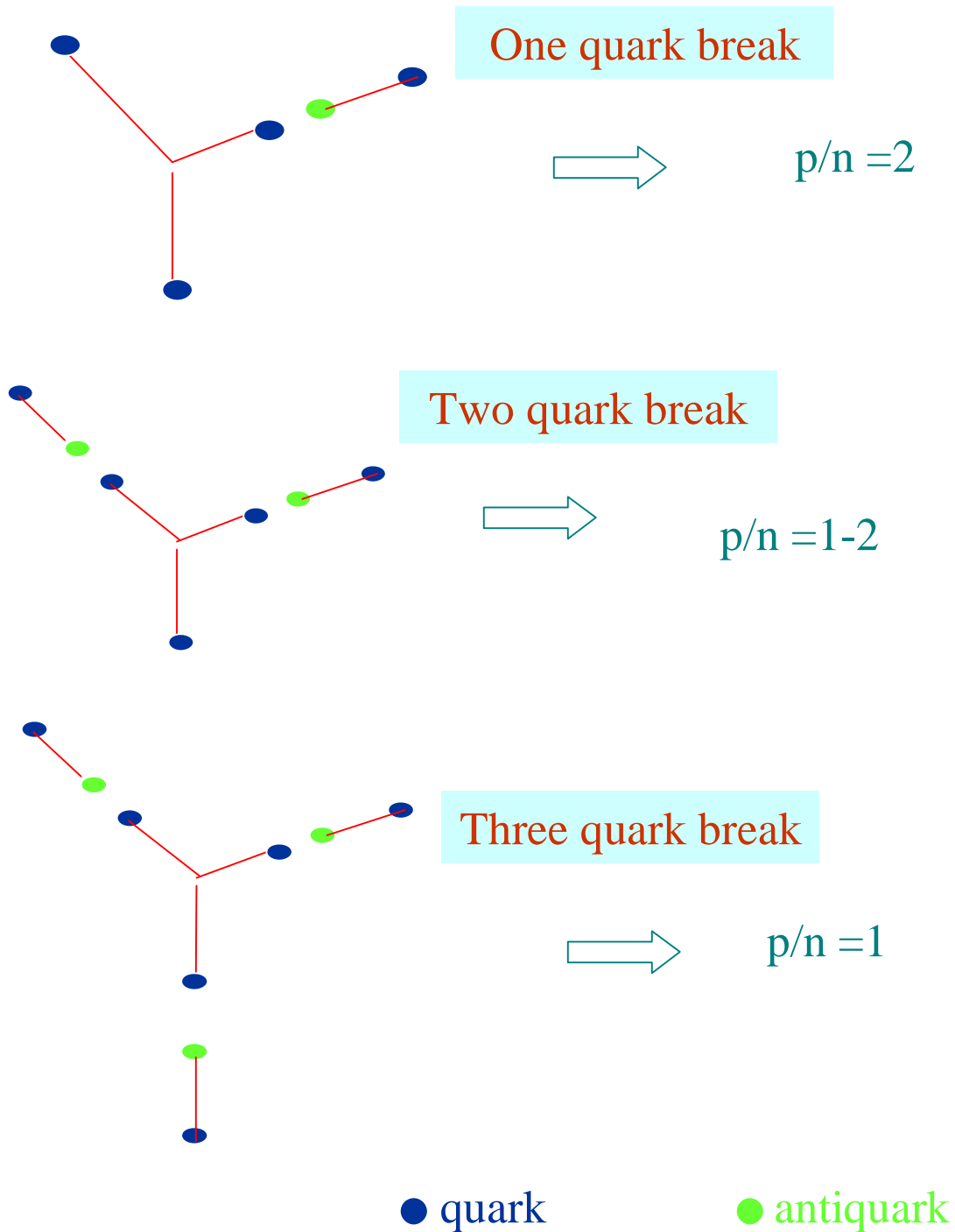


## $dN/dy$ of proton and neutron



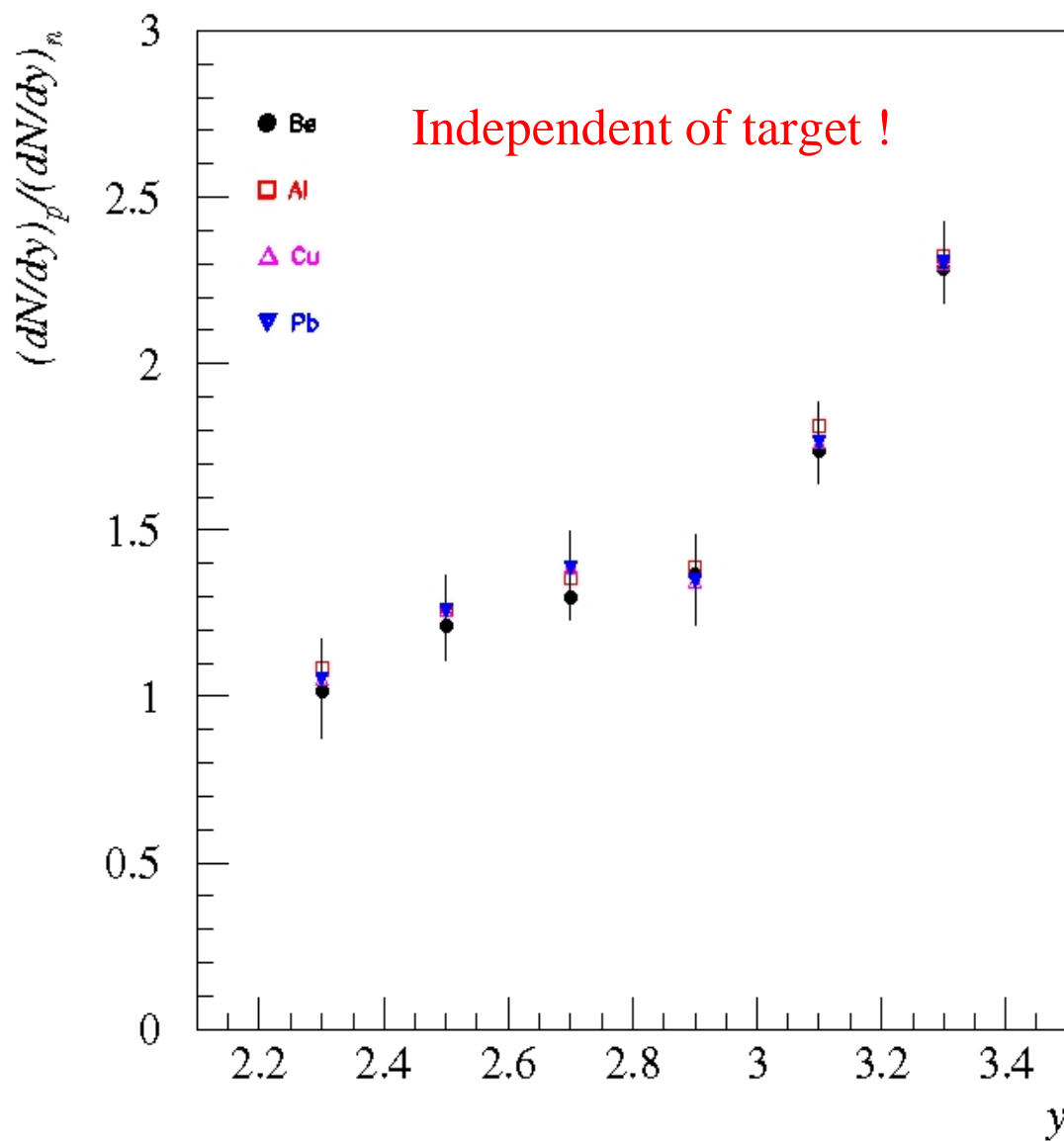
$dN/dy$  of neutron and proton for 4 targets at 19 GeV/c.

# The p/n ratio may reflect collision dynamics



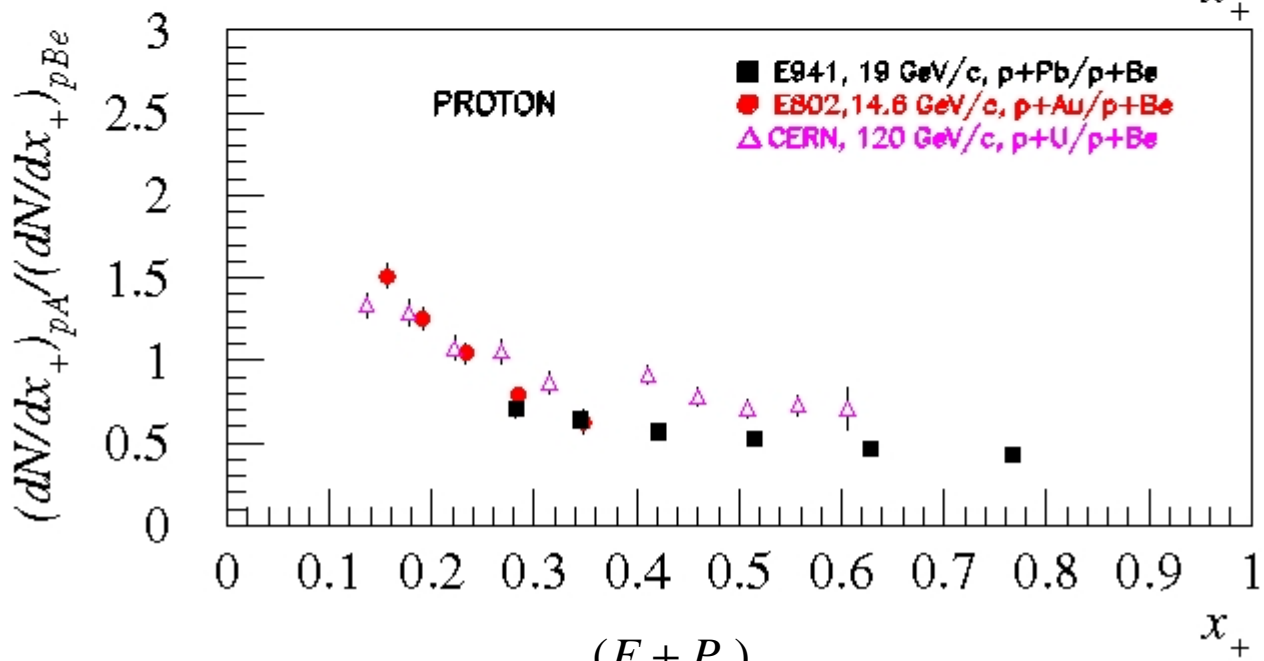
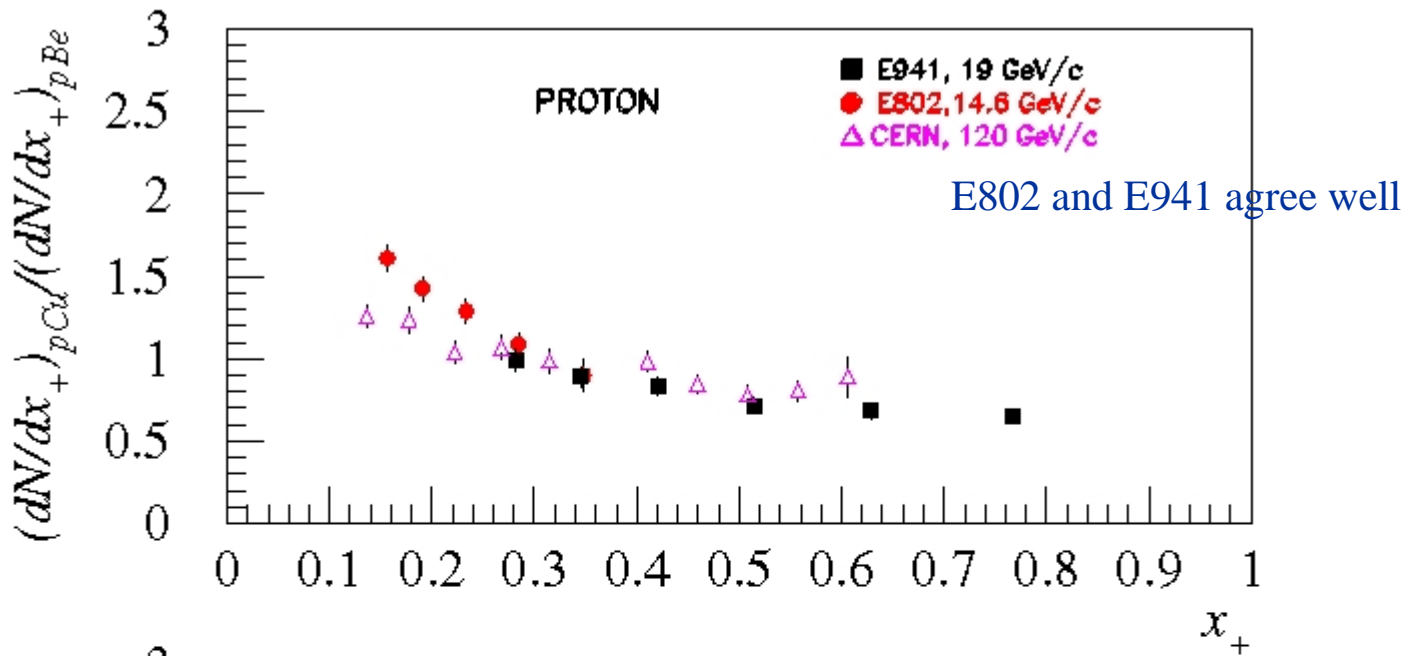


p/n ratio increases with rapidity



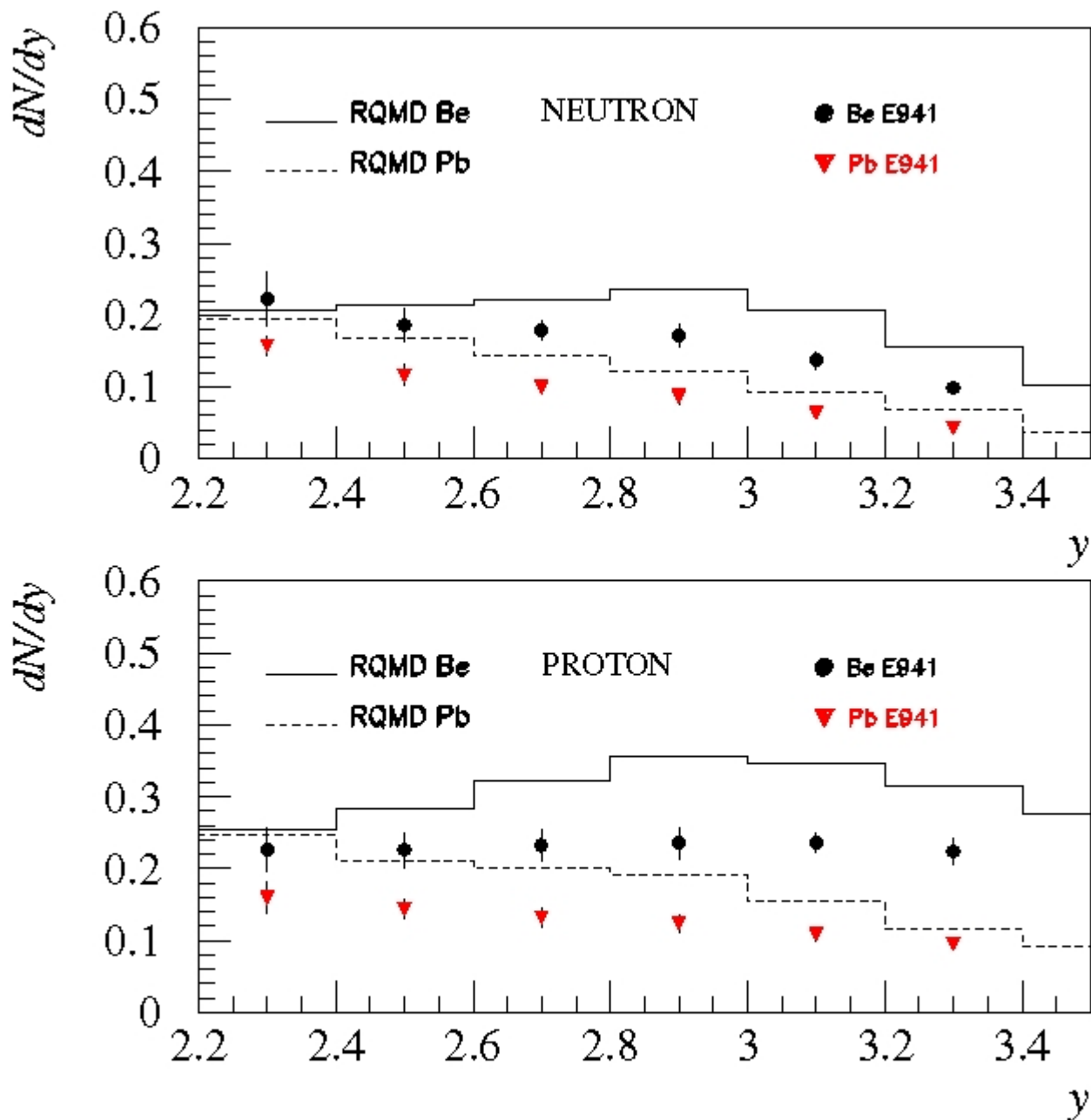
Ratio of proton to neutron as a function of rapidity for 4 targets at 19 GeV/c.

- ✓  $x_+$  distributions of the leading proton target dependence at the AGS and the CERN
- ✓ The energy scaling exists for the light target when  $x_+ > 0.25$



$$x_+ = \frac{(E + P_L)_c}{(E + P_L)_b}$$

# Comparing Data with Models



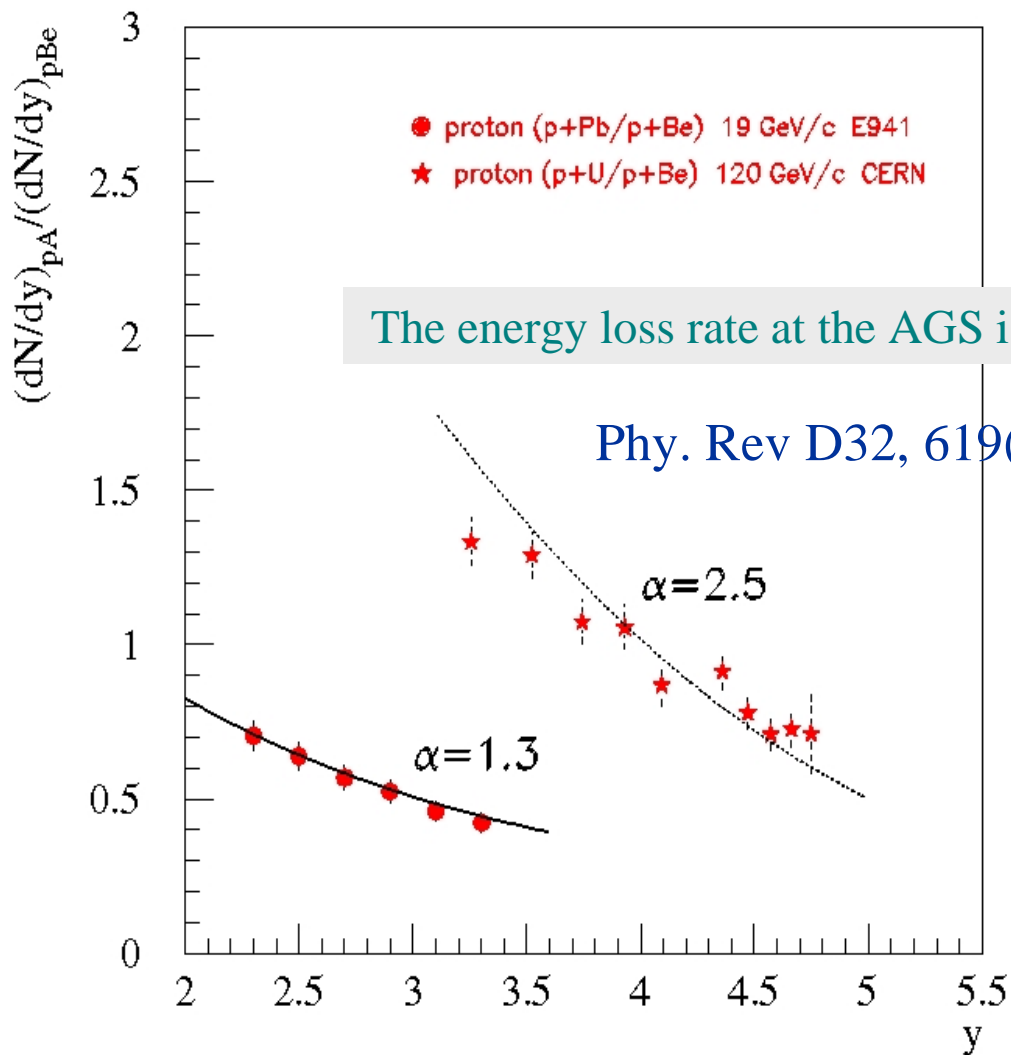
E941 data and RQMD\_v2.3c prediction  
for p+Be and p+Pb at 19 GeV/c

# A Sequential Collision Model

- The first collision = p+p a flat x distribution
- The rest of collision: power law energy loss

$$S_v(z) = \alpha z^{\alpha-1} \quad v \geq 2$$

$$dy = 1/a$$



# Antiproton production and absorption

Phy. Rev C47, R1351(1993)

E802 at 14.6 GeV/c  $y=1.3$

Weak target dependence

Allaby data at 19 GeV/c  $2.5 < y < 3.1$

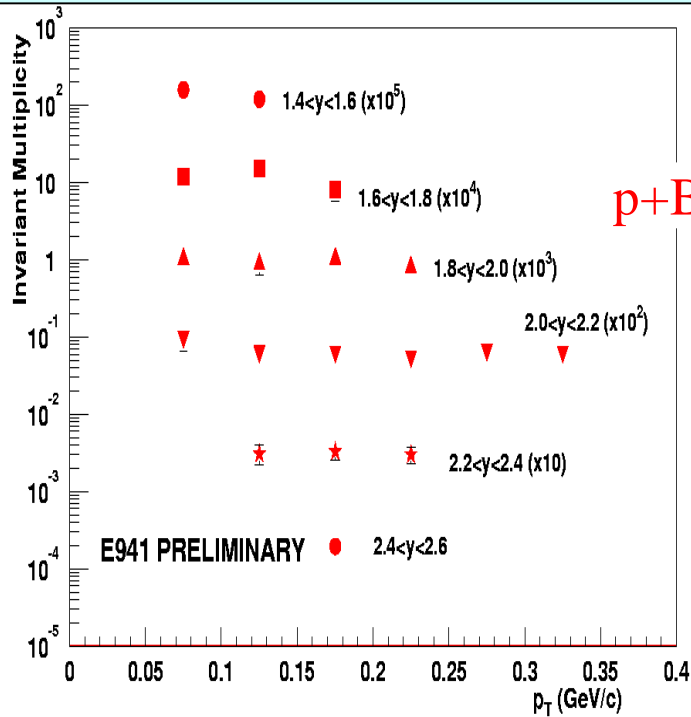
Strong target dependence

E941 can fill the gap  $1.5 < y < 2.3$

E864 : antihyperon/antiproton is about 2.8  
in Au+Pb at  $p_t=0$  and mid-rapidity

Important to investigate antiproton  
absorption in pA

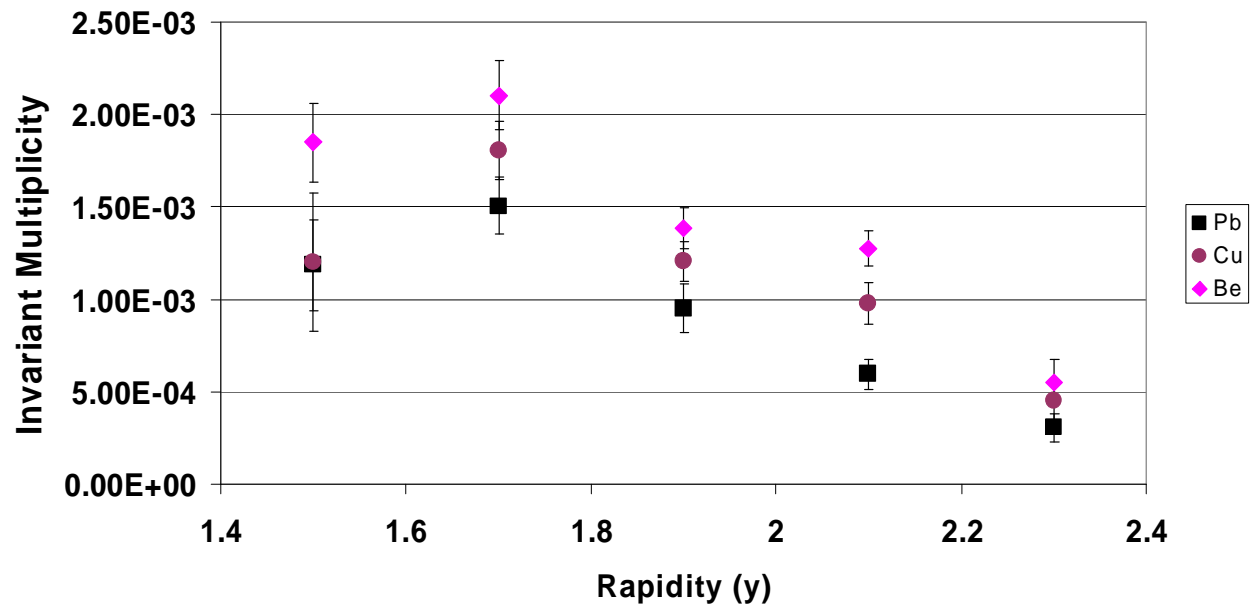
# Antiproton $p_T$ and rapidity distribution



p+Be at 19 GeV/c

Target Dependence at  $P_T = 125$  MeV/c

19 GeV/c

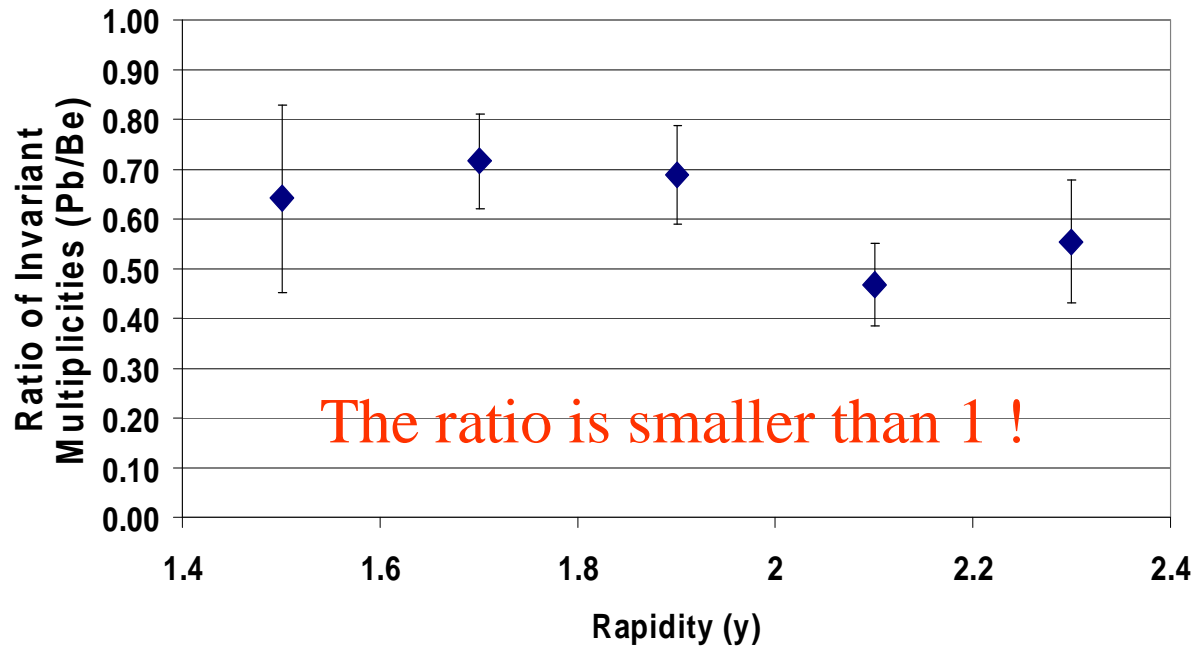


# The target and energy dependence of antiproton production

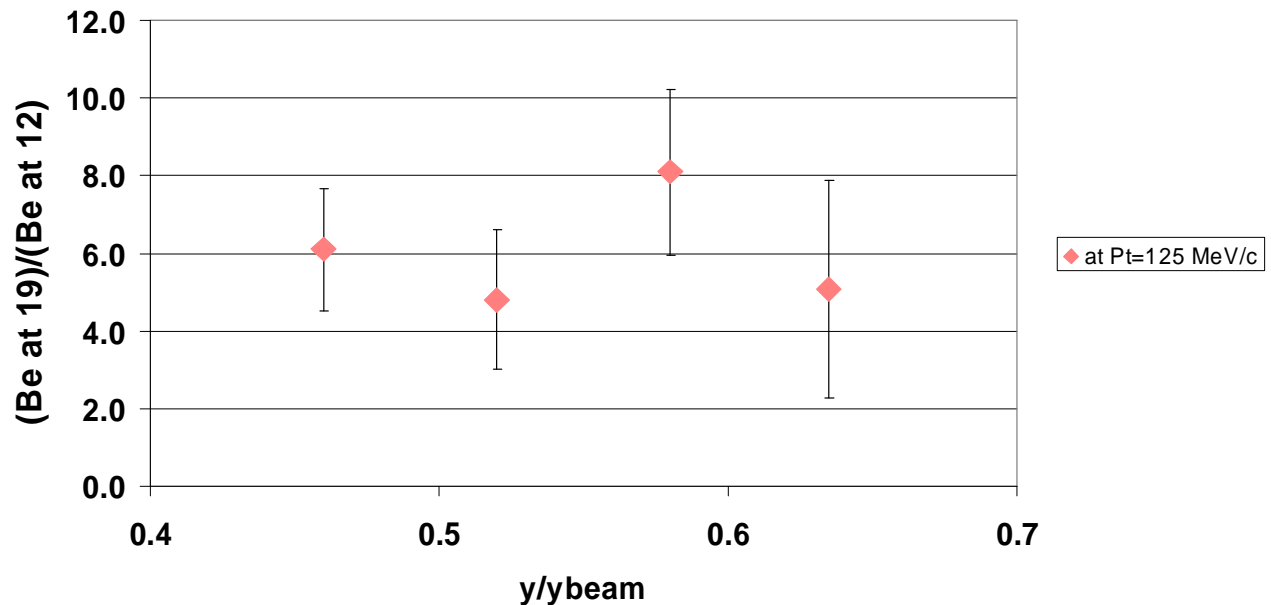
19 GeV/c

Target Dependence of Yields

Pt=125 MeV/c

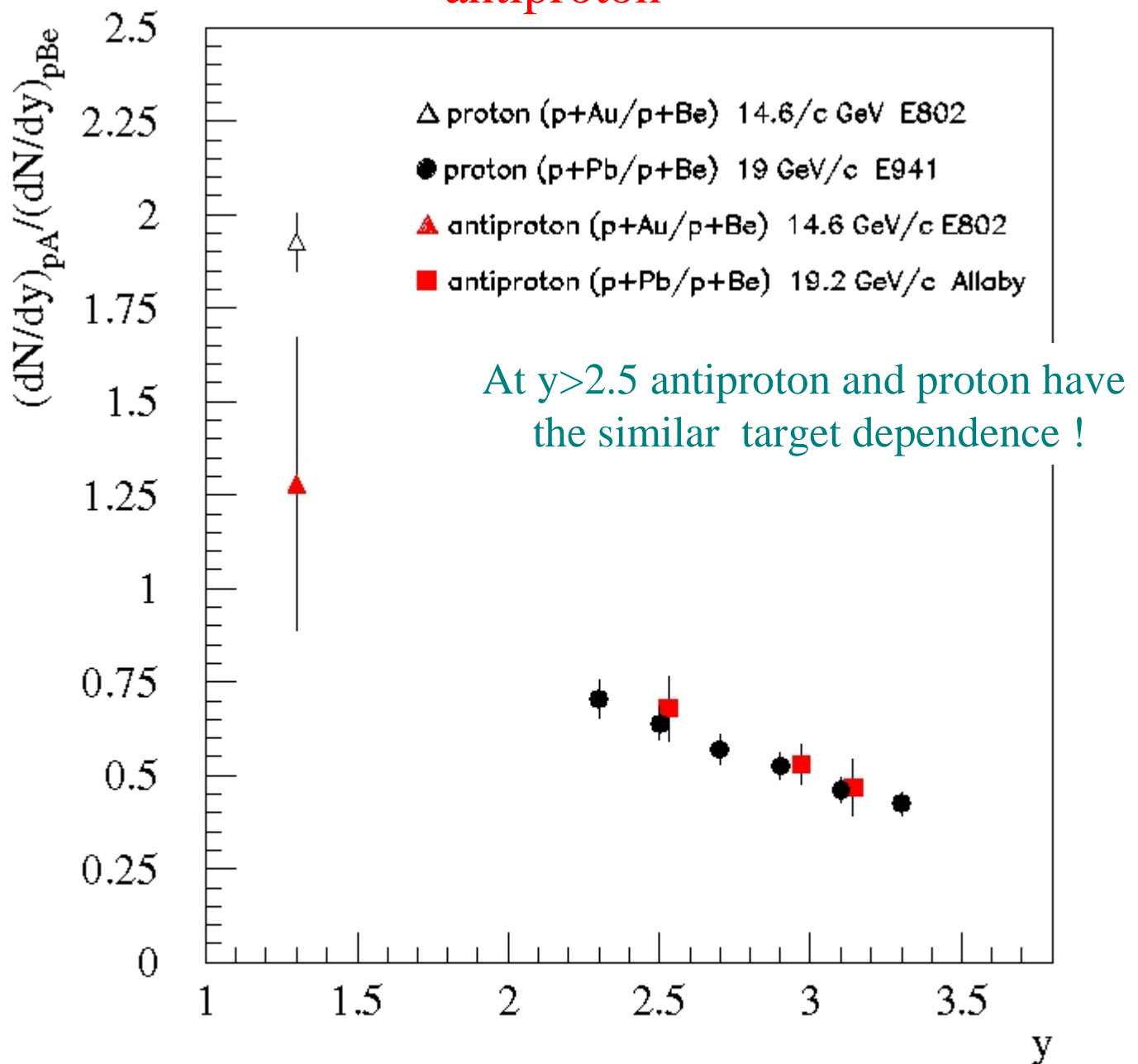


Energy Scaling of Yields



Jan. 14-21, 2001, Stony Brook

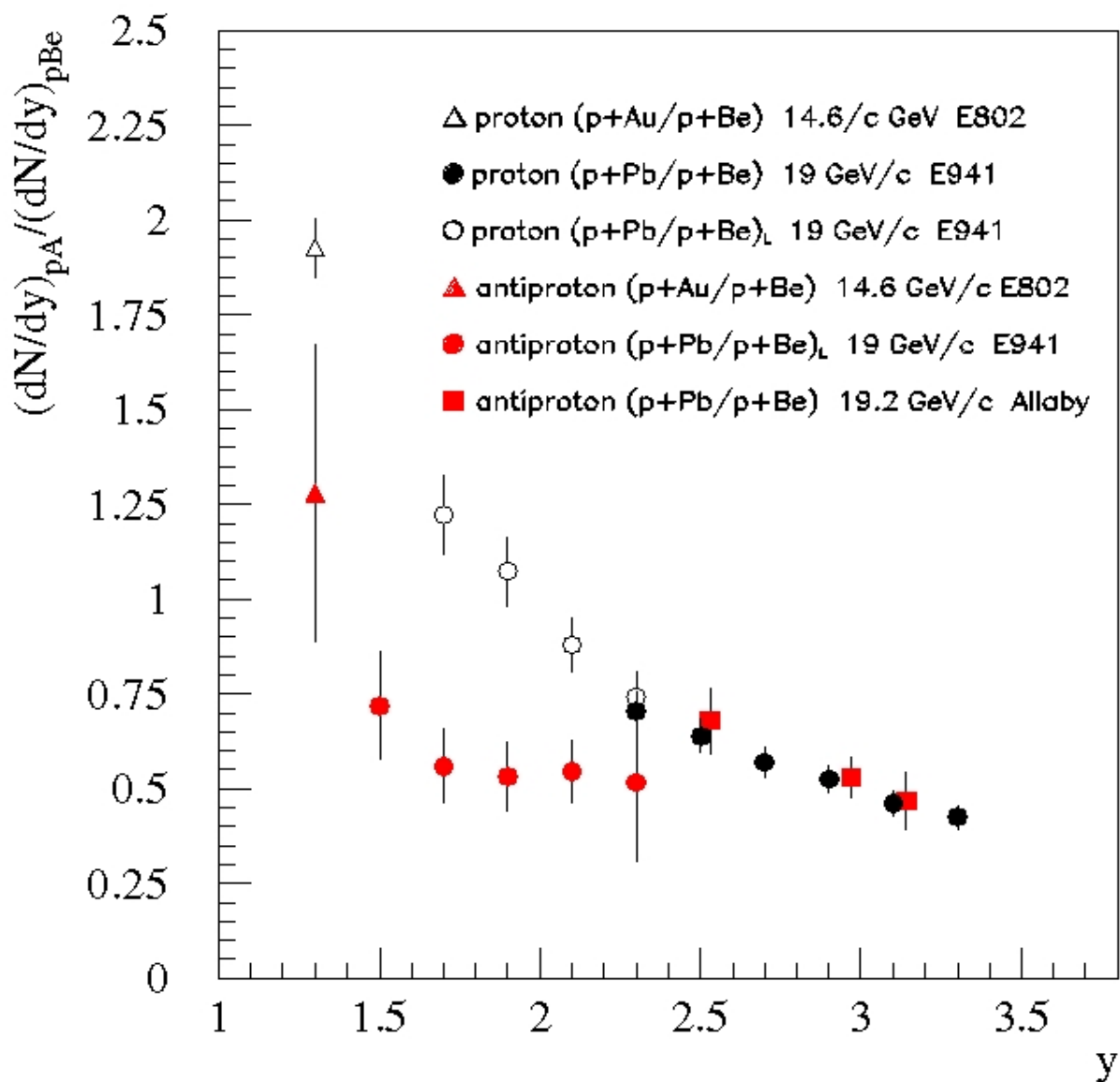
## Comparing the target dependence of proton and antiproton



$(dn/dy)_{pA} / (dn/dy)_{pBe}$  as a function of rapidity for proton and antiproton at 14.6 GeV/c and 19 GeV/c.



## Filling the mid-rapidity with $(dN/dy? pt)pPb/ (dN/dy? pt)pBe$



$$(dN/dy)_{pPb} / (dN/dy)_{pBe} \stackrel{?}{\approx} (dN/dy? pt)_{pPb} / (dN/dy? pt)_{pBe}$$

## Conclusion

- E941 measured leading baryon and antiproton production in pA collisions at the AGS energies.
- The p/n ratio increases with rapidity, but shows no target dependence.
- The target dependence of the leading proton does not follow energy scaling for the heavy target from the AGS to the SPS.
- RQMD overestimates the E941 data of leading baryon production.

## Conclusion

- In the large rapidity region ( $y > 2.5$ )  
Allaby antiproton data show the same target dependence as E941 protons in pA interactions at 19 GeV/c.
- E941 data show strong antiproton absorption in the region of  $1.5 < y < 2.3$ .